

PROCEEDINGS OF THE
ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 58

OCTOBER 1956

NO. 5

THE HELEID MIDGES INVOLVED IN THE POLLINATION OF RUBBER
TREES IN AMERICA
(DIPTERA, HELEIDAE)

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It has been my privilege to study an interesting collection of heleid midges captured by Dr. H. E. Warmke of the Federal Experiment Station, Mayaguez, Puerto Rico, in his studies on the pollination of the Para rubber tree, *Hevea brasiliensis* (Willd. ex. Adr. Juss.). Dr. Warmke stated in his reports (1951, 1952) on natural *Hevea* pollination that there was a close relation between the number of pollen grains and the presence of heleid body hairs on *Hevea* stigmas. Of a number of small insects captured in *Hevea* flowers, heleid midges of the genera *Atrichopogon*, *Dasyhelea*, and *Forcipomyia* were most frequently found bearing pollen grains among the hairs on their bodies. The purpose of this paper is to furnish identifications of the heleid species found to be associated with *Hevea* pollination, in order that the names may be used in Dr. Warmke's forthcoming publication.

Table I is a summary of the heleid collections¹ which form the basis of this taxonomic report.

TABLE I

Locality	Date	Number of Collections	Number of Specimens			
			<i>Atrichopogon</i>	<i>Forcipomyia</i>	<i>Dasyhelea</i>	Other
Puerto Rico, Mayaguez	1950	7	6	1	18	..
Puerto Rico, Mayaguez	1953	1	6	11
Brazil, Belém	1951	14	29	..	2	3
Costa Rica, Cairo	1953	1	1	..	1	..
Costa Rica, Los Diamantes	1953	2	12	11	..	1
Costa Rica, Turrialba	1953	3	21	4
Guatemala, Cuyotenango	1953	1	1	1	..	1
Mexico, Cozalapa	1953	3	5	7	..	2
Panama, Canal Zone	1953	1	..	1	5	..
Totals		33	81	36	26	7

¹These collections were made possible through the cooperation of the Division of Rubber Plant Investigations, ARS, U. S. Department of Agriculture, which sponsored Dr. Warmke's trips to Brazil and to Central America.

Seventy of the 150 specimens could be definitely assigned to the eleven species whose names are given below. The remaining 80 specimens, which are discussed in the taxonomic section, could be assigned only to genus or species group. The number of undetermined and undescribed species is estimated to be 20 in *Atrichopogon*, two in *Foreipomyia*, six in *Dasyhelea* and two in *Stilobezzia*.

With very few exceptions the midges found in *Hevea* flowers are common species of genera in the subfamilies Foreipomyiinae and Dasyheleinae, in the primitive section of the family Heleidae. These midges are habitual flower-feeders as adults and only exceptional groups of species have developed the insectivorous or blood-sucking habits which characterize the more highly evolved lines of the family (Gad, 1951). The flower-feeders are usually very small species, more or less densely covered with soft hairs and inconspicuously colored in contrast with the large, strong bodied, often very spiny, and conspicuously marked species of the predaceous genera. It appears that the *Hevea* pollinating species form no highly adapted or specialized biota, but consist mainly of a cross section of the commoner flower-feeding species of the family in the vicinity of the rubber groves. The species of Heleidae reported by Macfie (1944) as pollinators of cacao in Trinidad (Posnette, 1944) are apparently taxonomically and biologically very similar to the rubber pollinators.

The terminology used in this paper is the same as that explained in detail in my Heleidae of California (1951). Wing length is measured from the basal arculus. The value AR (antennal ratio) is obtained by dividing the combined lengths of the last five antennal segments by the combined lengths of the preceding eight, and TR (tarsal ratio) is the length of the hind basitarsus divided by the length of the second tarsomere.

The material studied, including the types of the new species, is deposited in the U. S. National Museum in Washington. All specimens, unless otherwise specified, were collected by Dr. Warmke while they were actually pollinating *Hevea*.

***Atrichopogon fuscus* (Coquillett)**

Ceratopogon fuscus Coquillett, 1901, Proc. U. S. Nat. Mus. 23: 605 (male; Riverton, New Jersey).

Atrichopogon fuscus, Ingram and Macfie, 1922, Ann. Trop. Med. & Parasit. 16: 244; Wirth, 1952, Univ. Calif. Pub. Ent. 9: 118 (synonymy, redescription figures).

COSTA RICA: Turrialba, W20,22, 20-27 March 1953, 2 males, 2 females; W13, 16 March 1953, 1 female; W14,15, Los Diamantes, 17 March 1953, 2 males.

BRAZIL: Belém, 2704, August 1951, in flowers of *Hevea*, 3 males.

These specimens appear to be identical with our abundant material of this widespread North American species. The Palaearctic *rostratus* (Winnertz) is very close, but more extensive material will have to be examined to investigate the possible synonymy.

Distinguishing characters of *fuscus* females: size large (wing 1.5- 2mm. long); thorax dark brown; eye bare; proboscis long, 1.3 times as long as height of eye; mandible bearing extremely large, sharp teeth at the apex, the teeth gradually becoming smaller proximad on the mandible; palpus with third segment slender, 3.5 to 4.7 times as long as broad, with small, very deep pit near the apex; spermathecae two, unequal, pyriform, abdomen with no ventral armature. In the male the ninth sternum bears an irregular double row of hairs proximad of the caudomesal excavation.

***Atrichopogon glaber* Macfie**

Atrichopogon glaber Macfie, 1935, *Stylops* 4: 50 (female; Tutoia, Brazil; fig. armature female abdomen); Macfie, 1938, *Proc. R. Ent. Soc. London* (B) 7: 162 (Trinidad; male, fig. genitalia); Macfie, 1953, *Beitr. zur Ent.* 3: 97 (Costa Rica).

BRAZIL: Belém, August 1951, No. 2700, in flowers of *Hevea*, 14 females; No. 2708, on stigmas of *Hevea*, 2 females; No. 2716, trapped in inflorescences of *Hevea*, 3 females; No. 2717, tanglefoot trap on petals of *Hevea*, 1 female; No. 2722, trapped in inflorescences of *Hevea*, 4 females.

COSTA RICA: Cairo, W18, 18 March 1953, 1 male. Los Diamantes, W14,15, 18 March 1953, 3 males. Turrialba, W20,22, 20-22 March 1953, 1 male.

The female of this species is characterized by its small size (wing 0.7-1.0 mm. long); uniform pale yellow color with only the antenna and palpus brown; third palpal segment short, slender, 2.3 times as long as broad with a small, deep, oblique pit, fourth palpal segment more swollen than third, the fifth segment short and pointed; antennal segments short, the proximal series subspherical to slightly transverse, AR 1.8, last segment with a long terminal stylet; eyes hairy; spermatheca single, subspherical to slightly oval with sclerotized neck; seventh sternum with ventral armature of a long pedunculated, three- to eight-branched process on the posterior margin and eighth sternum with a patch of long simple hyaline processes. The male genitalia possess a row of seven to nine hairs across the ninth sternum and the aedeagus has a distal complicated structure.

***Atrichopogon warmkei* Wirth, new species**

(Figure 1)

Female.—Wing 0.90 mm. long by 0.38 mm. broad.

Head dark brown, including palpus and antenna. Eyes hairy, broadly contiguous above antennae. Antenna (fig. 1c) with flagellar segments in proportion of 10:8:8:8:8:8:21:22:24:24:33, segments IV to X each slightly broader than long, XV with a long terminal stylet, AR 1.9. Palpal segments (fig. 1a) in proportion of 12:12:19:12:15, third segment unusually short and swollen with a small deep sensory pit. Mandible with very slender, pointed apex (fig. 1b) bearing about 12 minute, blunt teeth.

Thorax dark brown, mesonotum subshining, with two, pale, translucent lines extending from humeral depressions to ends of scutellum where they end in a pair of prominent elongate pale spots. Scutellum with four strong brown bristles. Legs yellowish, TR 2.7, seven spines in hind tibial comb.

Wing (fig. 1c) with costa extending 0.73 of distance to wing tip; both radial cells complete, second 0.37 times the length of first; nearly bare, a few macrotrichia in apices of cells R_3 and M_1 ; veins yellowish, the membrane grayish hyaline. Halter whitish.

Abdomen whitish, dusky above, first tergum with a transverse, translucent, blister-like area, the ends of which are connected to a widely separated pair of similar areas on second tergum, succeeding terga each with less apparent, sub-lateral areas. Spermatheca (fig. 1e) single, pyriform, heavily sclerotized, measuring 0.05 by 0.08 mm. Genital region without special armature.

Male genitalia (fig. 1d) as figured; ninth sternum with four bristles in a transverse row across middle; dististyle very short with slender, rounded, peg-like apex.

Holotype female, allotype, Mayaguez, Puerto Rico, 1-9 April 1953, in *Hevea* flowers, W25, PR2620 (Type No. 62914, U.S.N.M.). Paratypes: 3 males, 13 females, 9 females same data as type. 1 female, Coconut Grove, Florida, 27 August 1952, H. F. Loomis, near *Hevea* flowers. 2 males, 1 female, Miami, Florida, 20 December 1912, on *Persea* flowers. 2 females, Biscayne Bay, Florida, Mrs. Slosson. 1 male (genitalia only), Miami, Florida, 21 February 1944, W. W. Wirth, light trap.

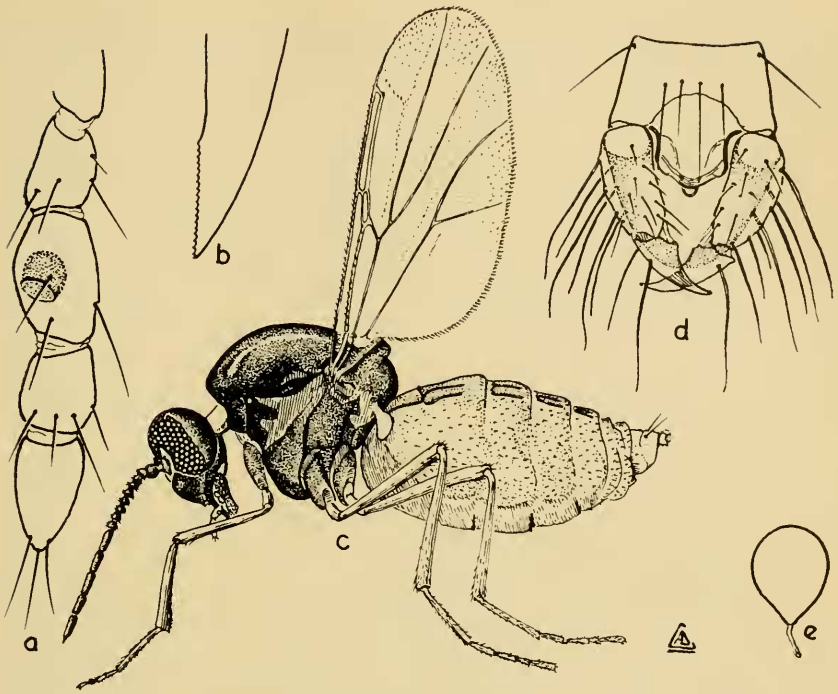
Atrichopogon websteri (Coquillett), a common and widespread Nearctic species, resembles *warmkei* in the possession of the pale mesonotal lines and the translucent areas on the basal abdominal terga, the pale halteres, transverse proximal antennal segments, single pyriform spermatheca, hairy eyes and four bristles on the male ninth sternum, but differs in its larger size (wing 1.1 mm. long), darker, more blackish color, hairier wing, more slender third palpal segment, longer serrated area on mandible (approximately 25 teeth) and longer, more pointed, male dististyle. *Atrichopogon nanus* Macfie from British Guiana is also very similar, but has dark halteres, TR over 3 and only five spines in the hind tibial comb.

I take great pleasure in dedicating this flower-visiting species to Dr. Warmke, who collected it in Puerto Rico.

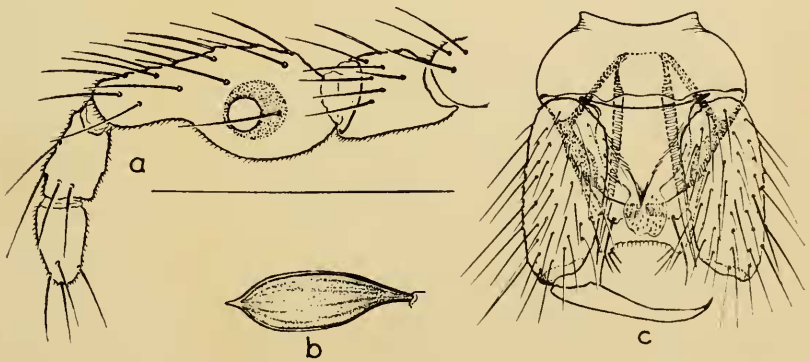
Atrichopogon spp.

The remaining specimens of *Atrichopogon* collected by Dr. Warmke superficially resemble *websteri* and *warmkei* in their small size, dark brown color, bare or nearly bare wings and single spermatheca, but nearly all differ among themselves in several important structural characters. There is a total of 16 males and 14 females representing at least 11 and 10 species respectively, and few of the males can definitely be associated by combinations of characters with any of the females. In the present state of our knowledge of this genus it would require a statistical study of long series to characterize each species.

Fig. 1, *Atrichopogon warmkei*: a, female palpus; b, apex of female mandible; c, female, side view; d, male genitalia; e, female spermatheca. Fig. 2, *Forcipomyia serrittata*: a, female palpus; b, modified scale from female tibia; c, male genitalia.



1. *warmkei*



2. *sexvittata*

Drawings by Arthur D. Cushman

It is moreover very likely that even then, as Nielsen (1951) discovered in Denmark, species which could easily be recognized in the larval and pupal stages could scarcely be differentiated, if at all, as adults.

Variation occurs in different combinations of such characters as eye hairy (15 specimens) or bare (7), halter dark (16) or pale (5), wing of female bare (5) or hairy at apex (6), translucent mesonotal lines and abdominal patches present (10) or absent (6), female antennal ratio from 1.4 to 2.7, tarsal ratio from 2.6 to 3.2, palpal pit of female deep (4), moderate (4) or shallow (3), mandible usually with 20-30 minute teeth, though in two females the teeth were large, in one larger towards the base and in the other larger towards the apex of the mandible, and in the male genitalia there may be on the ninth sternum four median bristles, one, two, three or four pairs of laterals, or a dense row of bristles.

BRAZIL: Belém, 2700, 2701, August 1951, on stigmas of *Hevea*, 1 male 1 female.

COSTA RICA: Turrialba, W20,22, 20-22 March 1953, 6 males, 5 females; W13, 16 March 1953, 4 males; Los Diamantes, W14,15, 18 March 1953, 2 males, 5 females.

GUATEMALA: Entre Rios, Cuyotenango, W12, 6 March 1953, 1 female.

MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7, 27 February 1953, 1 male, 4 females.

PUERTO RICO: Mayaguez, PR 2620, 1 April 1950, on *Hevea*, 1 female; W25, 1-9 April 1953, in *Hevea* flowers, 2 males.

Lasiohelea stylifera (Lutz)

Centrorhynchus stylifer Lutz, 1913, Mem. Inst. Oswaldo Cruz 5: 63 (female; Minas Gerais, São Paulo, Brazil; habits; fig. wing, palpus).

Lasiohelea stylifer, Macfie, 1939, Rev. Ent. 10: 171 (Brazil); Macfie, 1940, Proc. R. Ent. Soc. London (B) 9: 181 (British Guiana); Lane, 1945, Rev. Ent. 16: 362 (female redescribed); Lane, 1947, Arq. Fac. Hig. S. Pub. Univ. São Paulo 1: 161 (larva, pupa; fig. larva; Brazil); Macfie, 1953, Beitr. zur Ent. 3: 97 (Costa Rica; male, fig. genitalia); Ortiz, 1952, Rev. Sanid. Assist. Social 17: 241 (Venezuela; female redescribed, figured).

COSTA RICA: Los Diamantes, W14,15, 18 March 1953, 1 female.

This species is a notorious biter of man and animals in the Neotropical region. Distinguishing characters of the female:

Wing 1.0 mm. long, radial cells long and narrow, extending to 0.6 of wing length; macrotrichia numerous with bare lines next to veins scarcely perceptible; halter dark; eyes bare, contiguous above antenna for distance equal to diameter of about six corneal facets; antennal ratio 1.8, segments IV to X subspherical; third palpal segment greatly swollen, about twice as long as greatest breadth, with a very large open pit; mandible with about 22 teeth, those in mid portion very large, those on ends minute; a distinct buccal armature of about nine sharp spines in a curved row; thorax shining brown with dense brown hairs; legs pale brown; tarsal ratio 2.5; hind tibial comb with seven spines; claws slender, bent in middle, with a small tooth-like projection on side at the bend; spermatheca single, large, oval; scales of wing and tarsi long and slender, striate, not fringed.

Forcipomyia (Thyridomyia) nana (Maefie), NEW COMBINATION

Lasiohelca nana Maefie, 1939, Rev. Ent. 10: 171 (female; Nova Teutonia, Brazil);
Maefie, 1944, Bull. Ent. Res. 35: 297 (Trinidad; on Cacao flowers; male
deser., genitalia fig.).

COSTA RICA: Los Diamantes, W14,15, 18 March 1953, 1 male, 2 females. Turrialba, W13, 17 March 1953, 1 female.

GUATEMALA: Entre Rios, Cuyotenango, W12, 6 March 1953, 1 female.

MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7, 27 February 1953, 2 females.

A very small (wing 0.6-0.7 mm. long), uniformly dull brown species; antenna very short, proximal segments slightly broader than long, AR 1.0-1.2; third palpal segment with open sensory area, pit absent; eyes bare; mandible with 30-35 minute subequal teeth; TR 2.8; spermatheca single, subspherical; with a short sclerotized neck. Male genitalia with parameres typical of subgenus *Thyridomyia*, consisting of a pair of triangular plates with sharp mesal points nearly meeting each other; ninth sternum with a comparatively shallow, very faint, mesal excavation; aedeagus with a pair of contiguous caudomesal lobes and more strongly sclerotized pair of arcuate, pointed lateral processes with apices crossed mesad.

Forcipomyia species complex near *calcarata* (Coquillett)

COSTA RICA: Los Diamantes, W14,15, 18 March 1953, 1 male, 1 female. Turrialba, W20,22, 20-22 March 1953, 2 males, 1 female.

MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7, 27 February 1953, 1 female.

PUERTO RICO: Mayaguez, No. 25, 1-9 April 1953, in *Hevea* flowers, 5 males, 5 females; No. 2618, 1 April 1950, 1 male.

These specimens belong to a difficult group of species which according to Dr. L. G. Saunders (personal communication) are fairly easy to distinguish in the immature stages but as adults show only slight differences, even in the male genitalia. Species in this group are unmarked, dull grayish brown; rather small (wing 0.8-1.3 mm.); TR of female 1.4-2.1, of male 0.9-1.9; spur of hind tibia distinctly enlarged, the hind basitarsus sometimes incrassate; third palpal segment slender with a small round pit, third and fourth segments often fused; spermathecae two, subequal, pyriform. Male parameres consisting of a narrow, ribbon-like, U-shaped or V-shaped sclerotized band, sometimes with a pair of indistinct sclerotizations within the apex of the U or V; aedeagus simple with apex bilobed or caplike; ninth sternum not emarginate; dististyle often quite stout.

Forcipomyia fuliginosa (Meigen)

Ceratopogon fuliginosus Meigen, 1818, Syst. Besch. Eur. Zweifl. Ins. 1: 86 (Germany).

Forcipomyia fuliginosa, Goetghebuer, 1933, Rev. Zool. Bot. Afr. 24: 130 (combination); Wirth, Ann. Ent. Soc. Amer., IN PRESS.

MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7, 27 February 1953, 1 female; WS, 28 February 1953, swept from *Hevea*, 3 females.

PANAMA: Summit Gardens, Canal Zone, W23, 24 March 1953, 1 male.

In a paper now in press I have given an extensive synonymy and host and locality records of this common parasite of caterpillars and

sawfly larvae. Its distribution is world-wide and it has been most often referred to in the literature under the names of *inornatipennis* Austen and var. *ornaticrus* Ingram and *Macfie*, *kirtipes* (Meijere) and *flava* (Williston).

These midges are characterized by their large size (wing 1.5-2 mm. long); short basitarsus (TR 0.4-0.6); third palpal segment of female swollen to tip with a deep pit nearly the entire length of segment; body with numerous flattened scales.

Forcipomyia raleighi Macfie

Forcipomyia raleighi Macfie, 1938, Proc. Roy. Ent. Soc. London (B) 7: 160 (male, female; Trinidad; fig. male genitalia).

PUERTO RICO: Mayaguez, No. 25, 1-9 April 1953, in flowers of *Hevea*, 1 male.

Forcipomyia sexvittata Wirth, new species

(Figure 2)

Female.—Wing 0.93 mm. long by 0.40 mm. wide.

Head yellowish, palpus brown. Eye bare. Antenna with flagellar segments in continuous series, longer than broad, last six segments in proportion of 18:18:18:19:21:32; AR 0.63. Palpus (fig. 2a) with third segment 2.4 times as long as basal breadth, greatly swollen at base with a large round sensory cavity opening by a narrow pore, distal half abruptly narrowed; fourth and fifth segments not fused. Mandible vestigial, without teeth.

Thorax dull brown; mesonotum with three pairs of shining, brownish-black vittae, the mesal pair attaining anterior margin and ending in front of pre-scutellar depression, the two lateral pairs failing by their combined breadths to reach anterior mesonotal margin and extending caudad all the way to ends of scutellum. Mesonotum with short, semi-appressed, whitish pile; scutellum, postscutellum and lower pleuron dark brown. Legs with femora and tibiae dark brown and comparatively stout; tarsi pale; fore, mid and hind tibiae each with a dorsal row of broadly expanded, flattened, striated scales (fig. 2b); TR 0.9.

Wing unadorned, without pale or dark spots. Halter whitish.

Abdomen dark brown. Two large, oval spermathecae.

Male.—Similar to the female with usual sexual differences. Tibiae without broad scales. Genitalia (fig. 2c) with dististyle very slender and nearly straight; aedeagus shield-shaped, with anterior arch very low and anterior arms very short, bearing a sharp caudomedian point; parameres with a pair of rather stout, straight, sharp-pointed rods with bases widely separated, the area between their bases poorly sclerotized.

Holotype female, allotype, Los Diamantes, Costa Rica, 18 March 1953, H. E. Warnke, W14,15 (Type No. 62915, U.S.N.M.). Paratypes: 1 male, 3 females, same data as type.

The banding of the mesonotum resembles that of the European *pulchrithorax* Edwards but in that species the bands are not divided and the legs are pale and lack the broad scales. *Forcipomyia elegantula* Malloch from Illinois has the mesonotal vittae and lanceolate scales on the tibiae, but the lateral vittae are not subdivided, the wing bears a

large yellowish patch over the apex of the costa and the legs have only the apex of the hind femur dark. *Forcipomyia squamitibia* Lutz from Brazil to Mexico and *spatuligera* Macfie from Chiapas, Mexico have specialized tibial scales but otherwise bear little resemblance to the present species.

Dasyhelea spp.

No previously described species can be identified from the present material and the difficulty of the genus and the limited material available does not justify the description of any new species, although it is likely that all of the species are undescribed.

- BRAZIL: Belém, No. 2711, August 1951, on *Hevea stigma*, 1 male (species 1); No. 2723, August 1951, trapped in *Hevea* tree, 1 female (possibly species 1).
 COSTA RICA: Los Diamantes, W14,15, 18 March 1953, 1 female (yellow species 2). Cairo, W18, 18 March 1953, 1 female (small black, species 3).
 PANAMA: Canal Zone, Summit Gardens, W23, 24 March 1953, 3 males, 2 females (species 4, near *grisca* (Coquillett)).
 PUERTO RICO: Mayaguez, Nos. 2611, 2617, 29-31 March 1950, on *Hevea*, 6 males (species 5). Mayaguez, No. 2612, 3 April 1950, on *Hevea*, 9 females (possibly species 5). Mayaguez, No. 2618, 1 April 1950, on *Hevea*, 1 male (species 6). Mayaguez, No. 2619, 1 April 1950, on *Hevea*, 2 females (possibly species 6).

Culicoides diabolicus Hoffman

- Culicoides diabolicus* Hoffman, 1925, Amer. Jour. Hyg. 5: 294 (female; Panama).
 BRAZIL: Belém 2709, August 1951, on stigmas of *Hevea*, 1 female.

Culicoides jamaicensis Edwards

- Culicoides loughnani* var. *jamaicensis* Edwards, 1922, Bull. Ent. Res. 13: 165 (female; Jamaica).
Culicoides jamaicensis, Wirth, 1955, Proc. Ent. Soc. Washington 57: 112 (status; Guatemala; fig. male genitalia).
 GUATEMALA: Entre Rios, Cuyotenango, W12, 6 March 1953, 1 female.

Stilobezzia spp.

- BRAZIL: Belém, Nos. 2703, 2710, August 1951, on *Hevea*, 2 males.
 MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7 27 February 1953, 1 female.

The numerous Neotropical species of this genus are currently being revised by Dr. John Lane of the University of Sao Paulo, Brazil. The present specimens from Brazil are related to but distinct from *bulla* Thomsen and *thomsoni* Wirth from North America, and the Mexican specimen is most closely related among the described North American species to *sybleae* Wirth.

Echinohelea ornatipennis Macfie

- Echinohelea ornatipennis* Macfie, 1940, Proc. R. Ent. Soc. London (B) 9: 188 (male, female; British Guiana; fig. male genitalia).
 MEXICO: El Palmar, Cozalapa, Vera Cruz, W6,7, 27 February, 1953, 1 male.

This Mexican specimen is the first record of the species since it was described from British Guiana. It is easily distinguished from the two other British Guiana species, *richardsi* Macfie and *smartii* Macfie, and the North American *lanci* Wirth, by presence of two dark spots on the anterior wing margin. In other details, particularly the distinctive male genitalia, the Mexico specimen agrees closely with the original description given by Macfie.

SUMMARY

Identifications are given of the heleid midges which were found by H. E. Warmke to be associated with the pollination of the *Hevea* rubber tree in America. Thirty three collections of midges from *Hevea* flowers at eight locations in Puerto Rico, Central America and Brazil in 1950, 1951, and 1953 yielded 150 midges of which all but seven belonged to the genera *Atrichopogon*, *Forcipomyia* and *Dasyhelea*. Eleven species, including two new ones here described, could be definitely named, while 80 specimens comprising an estimated 30 species could be assigned only to genus or species group.

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BOOK NOTICE

CLASSICS OF BIOLOGY, by August Pi Suñer. Authorized English translation by Charles M. Stern. The Philosophical Library, Inc., New York. x + 337 pp. 1955.

Dr. Pi Suñer's work is a testimonial to his high standing in the world of human physiology, and Mr. Stern's translation is a faithful reflection of his writing style. The book is a review, necessarily brief because of the complexity of the subject, of the important physiological principles governing all living things. Appropriate quotations from the classical writings on each phase of the subject are included.—RICHARD H. FOOTE, *Entomology Research Branch, U. S. Department of Agriculture, Washington, D. C.*